

Supplementary Material

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Introduction

Additional details related to soil and house dust collection and processing and XRF measurements of lead and other trace elements are reported below.

Soil and House Dust Sample Collection

Soil and house dust samples were collected from 163 of the study participants' homes and from each of the nine schools by two of the authors (L.G. and D.A.) during the summer of 2008. All but one of the homes and schools sampled fell within an approximately two mile radius of the Kiteezi/Mpwerere Landfill. Soil samples were obtained by four-inch diameter sediment cores pushed into the ground to collect most superficial centimeter of soil where recent atmospheric deposition is expected to have accumulated without major dilution. Dust samples were collected by sweeping material from a two ft² area of the floor (and some windowsills) in each home into a dust pan from the participant's home. The most common flooring materials in the homes included in this study were either dirt floors or cement. The cement was occasionally reported to be painted, which raised the concern of additional lead inputs from lead-based paint deterioration. The soil and house dust samples were stored in plastic zip-locking bags at ambient temperature until they were processed for analysis.

Sample Preparation

Soil and dust samples were sterilized in a Wisconsin Aluminum Foundry Co, Inc. All-American 25-X Steroclave. This process exposed samples to a controlled temperature and corresponding pressure equal to or greater than 121 °C and 15 psi to inactivate any fungi, spores, bacteria or viruses which may have been present. The samples were then dried at 35 °C to remove residual moisture in preparation for grinding and sieving. Each sample

was ground for approximately 30 seconds with a porcelain mortar and pestle to achieve a level of homogeneity required for chemical analysis. Some soil and house dust samples contained pieces of charcoal, dried grasses or other organic matter, mouse pellets, paint chips and/or packaging scraps, which was noted prior to grinding. Large, gravel-sized particles or large pieces of charcoal were removed prior to grinding. The ground sample was then sorted with a U.S. Standard No. 60 sieve corresponding to sediment with a diameter of 250 microns. Sediment passing through the sieve was weighed and packed into sample cups for analysis. Dust samples with less than 1.5 grams of sediment less than 250 microns in diameter were diluted to obtain a mass great enough for elemental analysis by X-ray fluorescence (see discussion below).

X-ray Florescence Analysis

A Spectro Xepos II X-ray florescence spectrometer (XRF) was utilized to determine the concentrations of elemental components of the soil and house dust samples.

Quantification was accomplished using the TurboQuant Powder software from the manufacturer and checked for accuracy and precision with multiple analyses of Standard Reference Materials (SRMs) and a secondary standard.

Results for National Institute of Standards and Technology (NIST) soil and sediment SRMs (2702, 2704, and 2709) are plotted against certified values in Figure S-1. Also shown are data from XRF analysis of a laboratory standard – SLOSH III, Hudson River sediment plotted against accepted values derived from over twenty analyses that used total acid digestion followed by flame atomic absorption spectroscopy or ICP/MS.

Agreement with certified or accepted values was within about 5% for Pb and several other trace elements including Cu, Zn, Co, Cr, and Ni. A more detailed presentation of the Pb and Cu data is shown in Figure S-2.

Dust Sample Dilution

Dust samples with less than 1.5 grams of material passing through a No. 60 sieve required the addition of supplementary material of a know composition to increase the samples mass for XRF analysis. The recommended mass for sediment samples is 3.0

grams, however multiple analyses of standard samples at lower masses have shown that lead and many other trace and major elements are detected at concentrations within about 5 percent of the certified values at masses as low as 1.2 grams. Due to the instrument's high level of sensitivity it was expected that elemental concentrations of the house dust samples could be calculated from the linear combination of known quantities of diluting material and unknown sample based on the instruments response to the diluted sample.

Two diluting materials, silicic acid (Bio-Sil A) and alumina (Bio-Rad neutral alumina AG-7), were considered for the dust sample dilutions. Both were found to be acceptable diluents, with consistent and low levels of lead and most other trace metals (Table S-1). Homogeneous diluted samples were prepared by briefly grinding dust and diluent with a mortar and pestle. Dilution experiments were performed with alumina and silicic acid for Slosh III (Figure S-3) and for sample UGD 5026 (Figure S-4), one of the larger samples of house dust. Even at the relatively low level of lead in UGD 5026 (~ 40 ppm), acceptable precision was maintained with only about 0.1 grams of sample diluted to 1.5 grams with alumina or silicic acid. The great majority of dust samples analyzed using the dilution technique contained several tenths of a gram. Only five samples had less than 0.1 grams and the smallest was 0.07 grams. Although both diluents gave similar results for lead (Figures S-3 and S-4), silicic acid was chosen for the dilution of the Uganda house dust samples because of the relatively high concentration of zinc (191.5 ± 8.5) in the alumina powder.

Additional Quality Assurance/Quality Control

Seven soil samples were analyzed for lead by XRF in triplicate. The average relative standard deviation was 1.0%. Duplicate analyses for lead on fifteen soil samples gave a mean relative percent difference of 4.3%. Duplicate analyses were conducted on six non-diluted dust samples and the mean relative percent difference for lead was 1.7%. For duplicates of five diluted dust samples, the mean relative percent difference was 4.0%.

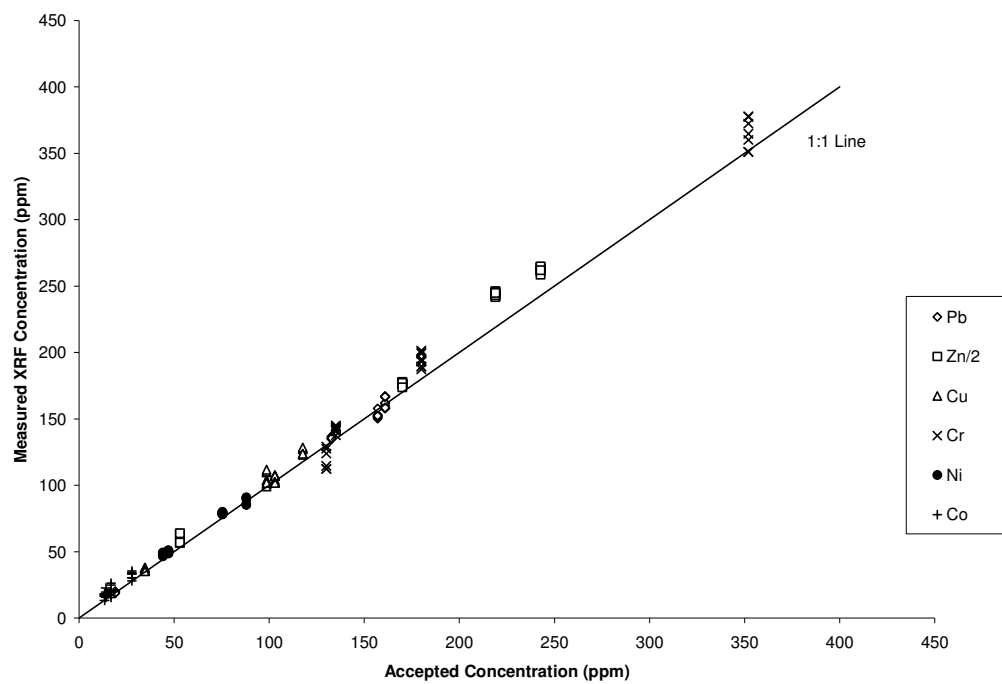


Figure S-1. XRF results for trace element analyses of SRMs and SLOSH III versus accepted values.

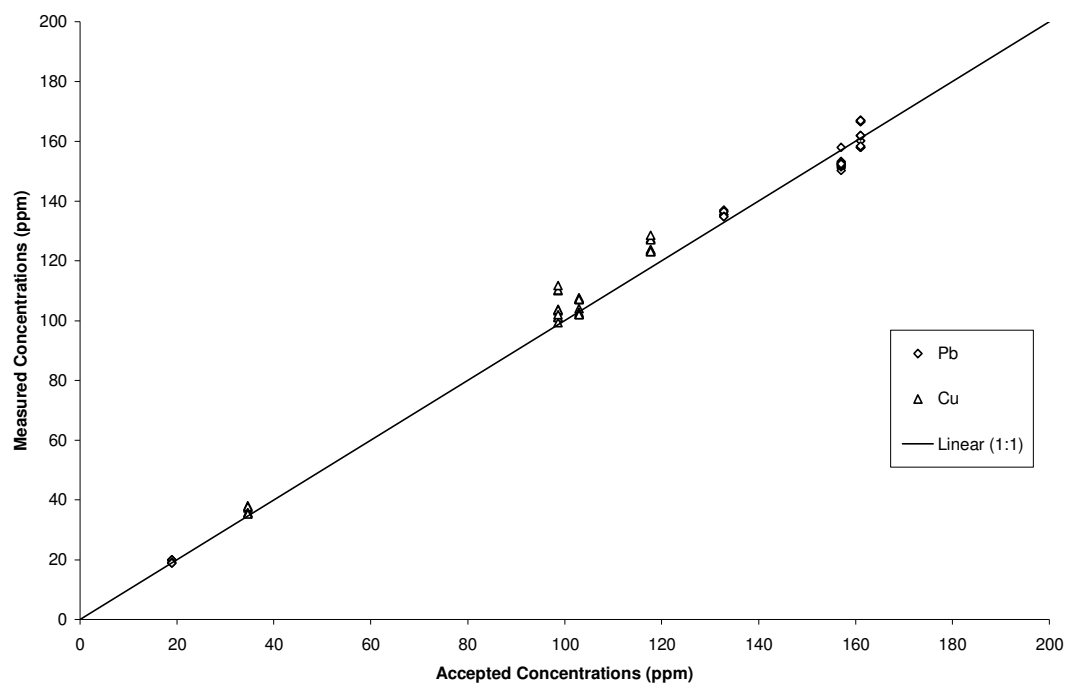


Figure S-2. XRF results for Pb and Cu analyses of SRMs and SLOSH III versus accepted values.

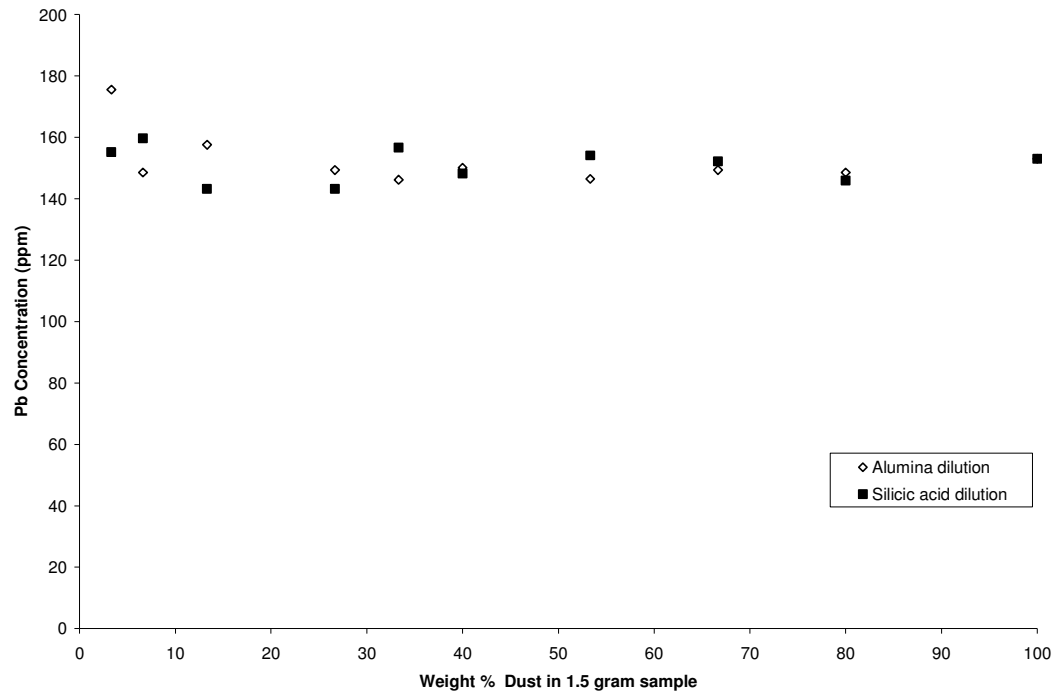


Figure S-3. Calculated Pb concentrations for sediment standard Slosch III diluted with alumina and silicic acid.

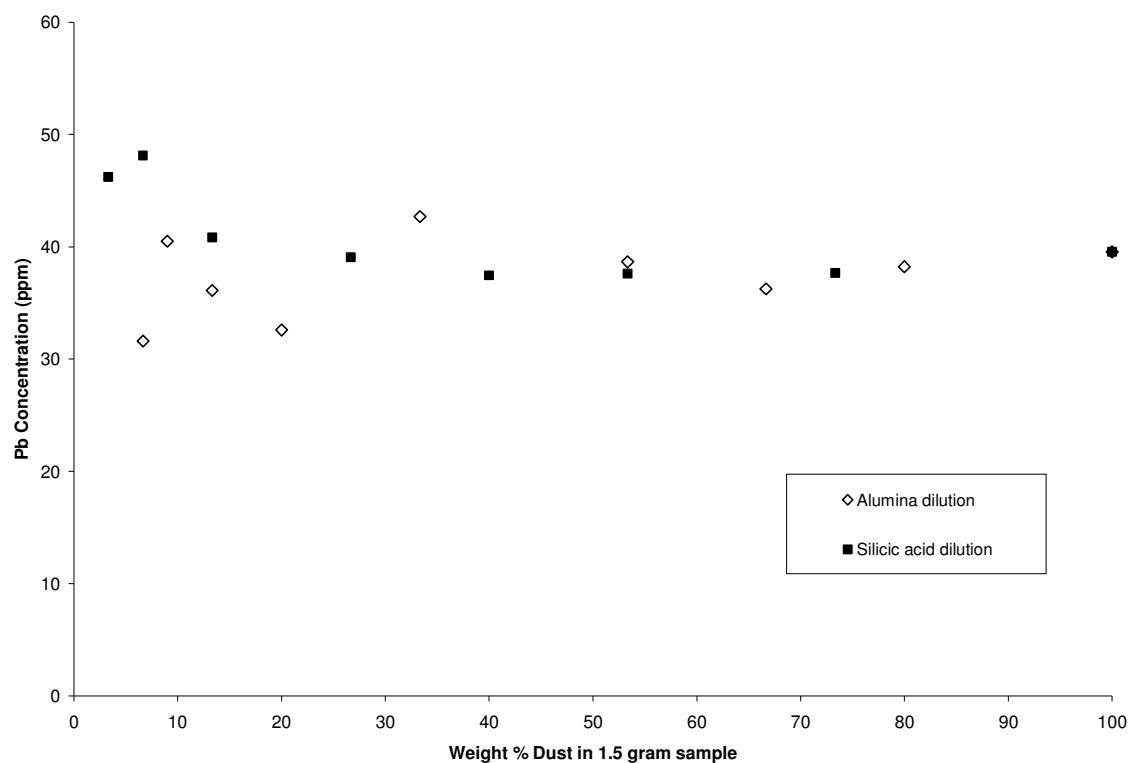


Figure S-4. Calculated Pb concentrations for house dust sample UGD 5026 diluted with alumina and silicic acid.

Table S-1. Trace Element Concentrations in Diluting Materials.

Analyte	n	Silicic Acid			n	Alumina		
		Mean	$\pm 1\sigma$	Range		Mean	$\pm 1\sigma$	Range
Cu	11	5.79	± 0.31	5.3 - 6.3	3	2.27	± 0.25	2.0 - 2.5
Pb	11	2.03	± 0.27	1.7 - 2.6	3	1.33	± 0.29	1.0 - 1.5
Zn	11	13.27	± 0.58	12.6 - 14.6	3	191.57	± 8.49	185.7 - 201.3
Cr	11	< 1.0			3	< 1.0		
Ni	11	0.96	± 0.21	0.5 - 1.3	3	1.00	± 0.71	<0.4 - 1.5
Co	11	< 3.0			3	< 3.0		
As	11	< 0.5			3	< 0.5		
Sn	11	19.54	± 1.68	17.4 - 22.3	3	17.00	± 5.72	10.4 - 20.5